CAPTEM-LEAG Lunar Sample Acquisition and Curation Review (LSACR)

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Charter for the CAPTEM-LEAG LSACR

- **Response to:**
  - NAC S-07-C-9 Sample Collection, Documentation, Containment and Curation
  - NRC 4R Updating Lunar Sample Collection Techniques and Curation Capabilities
- **CAPTEM and LEAG, jointly, are requested to review lunar sample acquisition, curation and the potential distribution of samples for scientific studies, with consideration including, but not limited to the following:**

Impact of sample return on critical engineering requirements for Constellation.

Protocols for sampling and curation during lunar surface activities.

Curation protocols and facilities on Earth.

LSACR TEAM

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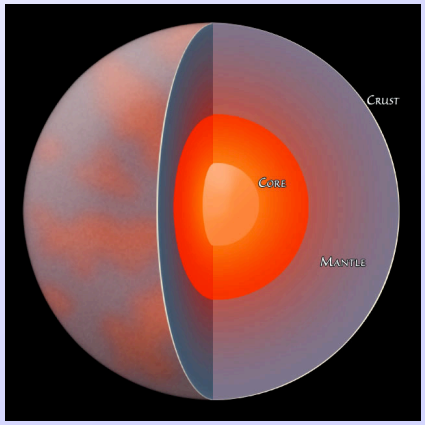
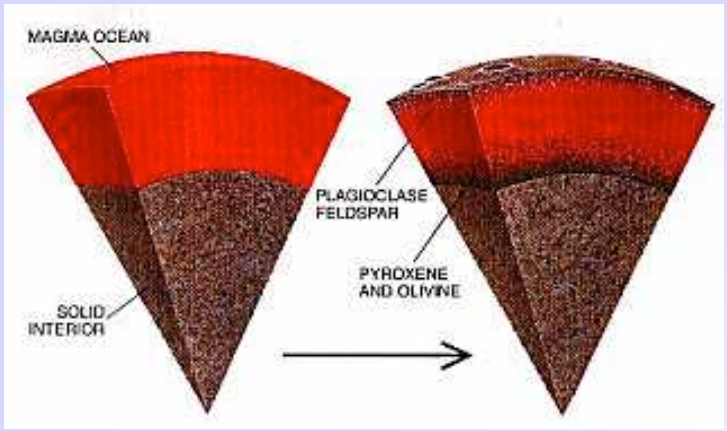
Importance of lunar samples for understanding the Moon and the solar system

- The exploration of the Moon that climaxed with Apollo resulted in a paradigm shift in not only our understanding of the Moon but in our scientific appreciation of fundamental processes at work in the solar system.
- The collection and return of lunar samples was critical to this immense intellectual step.





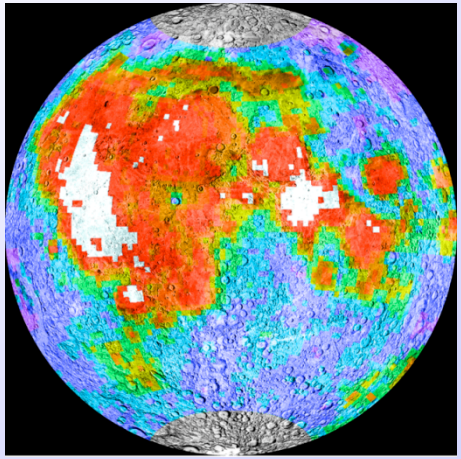
Nature and evolution of the lunar interior

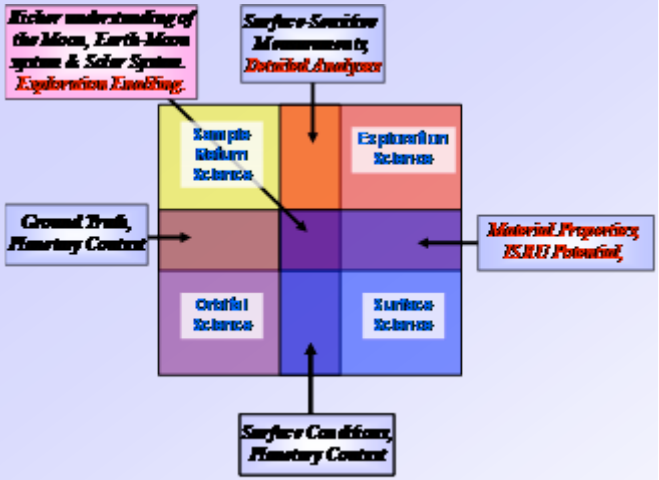
Primordial differentiation of the planets

Early impact history of the solar system

Lunar samples and the future exploration of the Moon

As we look forward to a new period of lunar exploration, the importance of samples looms even larger. This importance is tied to three concepts:





Apollo explored and sampled a relatively small area of the Moon and therefore our understanding of the Earth-Moon system is incomplete.

Sample analysis in terrestrial labs provide a unique prospective unavailable by other exploration tools.

The symbiotic relationship among sample-surface-orbital observations is invaluable for the exploration-habitation of the Moon and feeds forward to the exploration of the solar system.

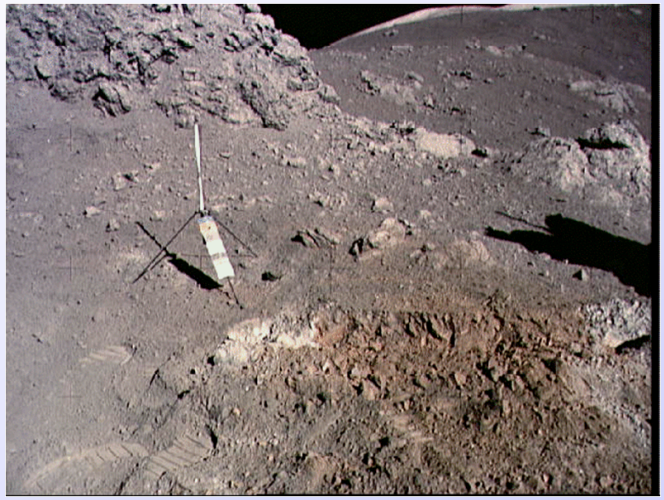
Themes

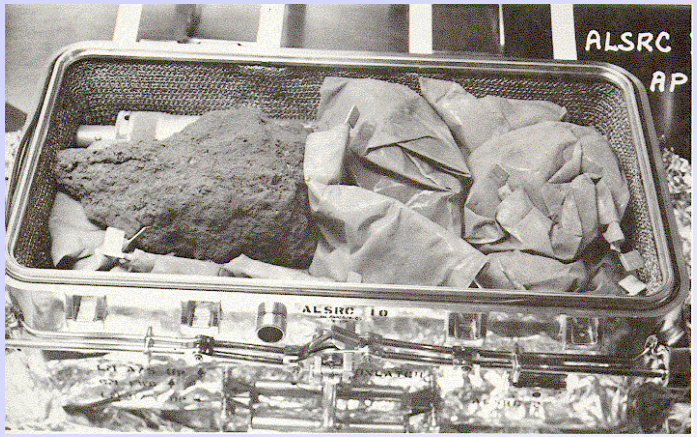
- **Part 1. Surface activities for sample acquisition and curation**
  - ***Sample Acquisition Tools***
  - ***Instrumentation for sample selection***
  - ***Sample packaging and preservation***
  - ***Sample contamination control***
  - ***Sample mass and volume***
  - ***Power needs***
  - ***Crew training***
  - ***Communication and Flight Control***
  - ***Protocols for Sampling and Curation on the Moon***
- **Part 2. Curation protocols & facilities on Earth**

Themes- Example

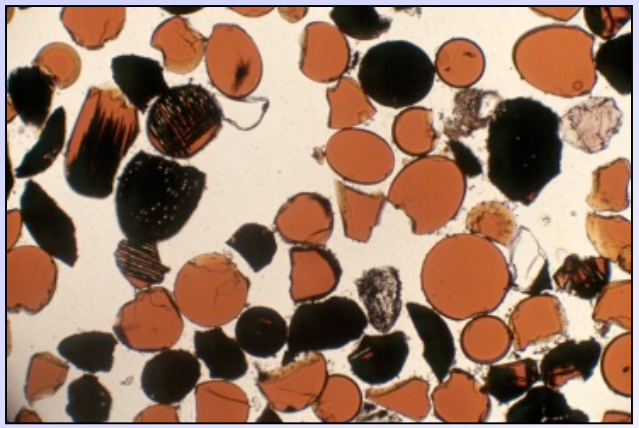
- **Part 1. Surface activities for sample acquisition and curation**
  - ***Sample Acquisition Tools***
    - **Lessons learned from the Apollo Program**
    - **Advances since the Apollo Program**
    - **Capabilities for sampling the lunar surface**
      - **Sortie missions**
      - **Outpost activities**
    - **Specific engineering requirements.**
    - **Analyses needed prior to establishing recommendations.**
    - **Findings.**

Themes- Examples of findings linked to sample mass and volume





Geologist prepares to open a core tube of soil from the Moon inside a cabinet filled with pure nitrogen

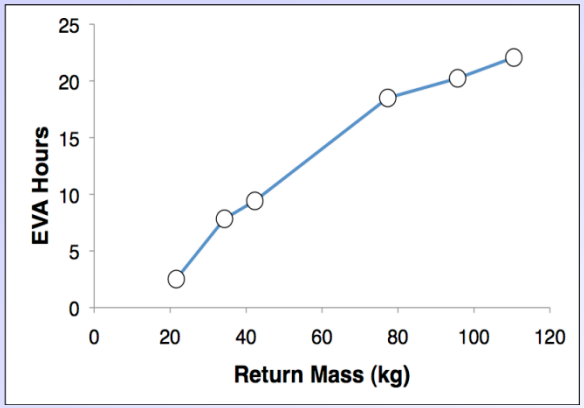


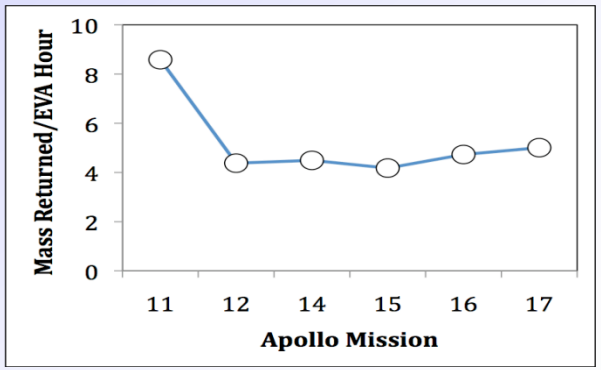
Themes- Examples of Findings

Sample mass and volume

Finding 1: Constellation architecture should be able to accommodate approximately 250 kg of sample and sample containers.

Finding 2: A volume of 0.10-0.12 m^3 is required per 100 kg of lunar samples.



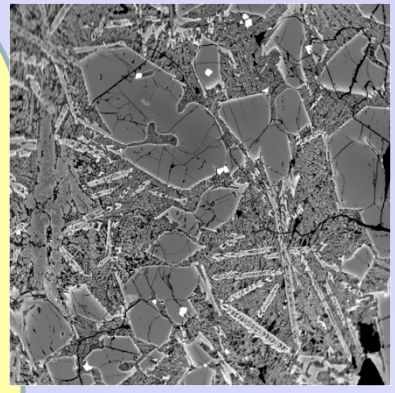


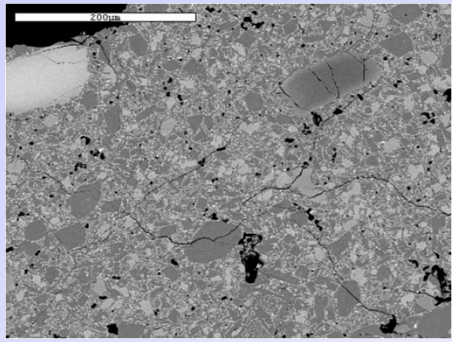
Themes- Examples of Findings

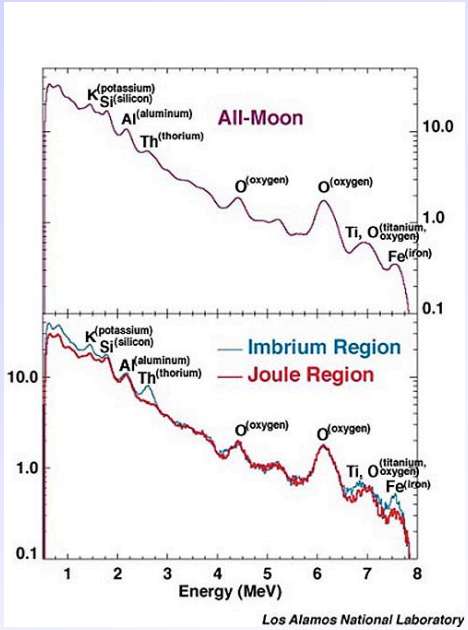
Analytical instrumentation needed for sample selection

Finding 1: The large sample mass that could potentially be collected during sortie missions require culling samples of scientific and exploration importance.

Finding 3: Sample "high-grading" for return to Earth can be accomplished with analytical instruments + astronaut observations. Instruments must be easy to use and interpret. They should provide mineralogical and geochemical fingerprints of samples.







Themes- Examples of Findings

Sample packaging and preservation.

Finding 2: To reduce sample container volume, we find that soft goods sample return containers my provide an alternative to the ALSRC. Prior to the use of this style of container, it is imperative that sample preservation and contamination issues are investigated and resolved.

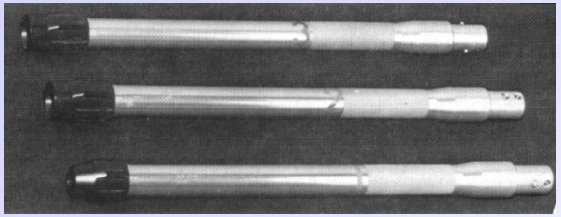
Themes- Examples of Findings

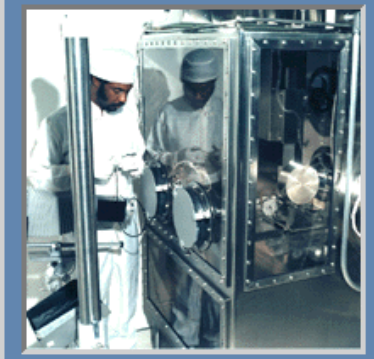
Sample contamination control

Finding 3: Contamination control protocols must be established for sample handling and curation during outpost "high-grading" and science activities.

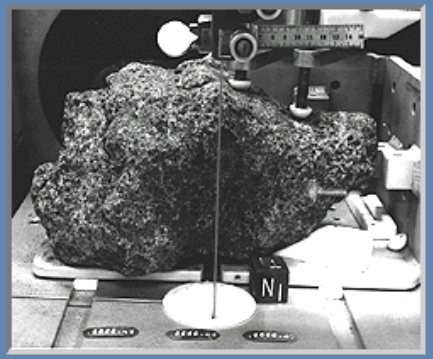
Fig. 86. Gas Analysis Sample Container (GASC). The knife-edge on the can and indium alloy sealing surface on the lid are visible (NASA photo S88-52660 taken from Union Carbide photo no. 121372).

Geologist prepares to open a core tube of soil from the Moon inside a cabinet filled with pure nitrogen





The processor is photographing the sample in the bandsaw cabinet.

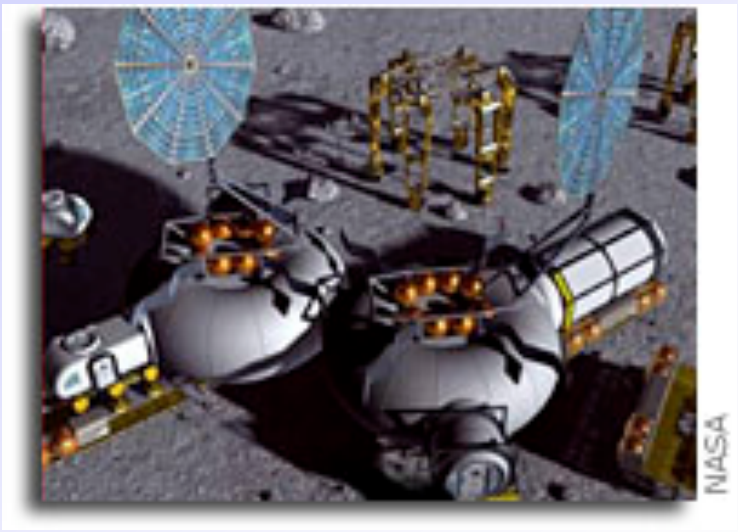


This Apollo 15 basalt, 15555, is ready for its first saw cut.

Themes- Examples of Findings

Power

Finding 3: Return vehicles must support the power (and volume) needs for environmental control (refrigeration) for geologic and biologic samples.



Themes- Examples of Findings

Crew training for sample acquisition and curation

Finding 3: All astronauts should be trained for efficiency in/with the fundamental field geology skills, hand specimen petrography, sample collection tool use and protocols, science instrument use, navigation and rover operation, sample collection protocols, outpost laboratory analytical capabilities, inventory and data management, and SSR interaction.

Schedule for LSAC Review

- **Part 1. Surface activities for sample acquisition and curation.**
  - **August 1-7, 2009 : Draft of while paper reviewed by team members.**
  - **August 20, 2009 : Draft of white paper forwarded to OSEWG.**
  - **September 1, 2009: Final draft available.**
- **Part 2. Review of curation protocols & facilities on Earth.**
  - **October 2009: Review current lunar curation facilities and evaluate future needs.**
  - **April 2010: Final draft available.**